Presented by Professor Hilson, F.R.S.

THE LEPROUS DISEASES OF THE EYE

WITH 6 COLORED PLATES

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THE LEPROUS DISEASES OF THE EYE.

Nearly all the affections to which leprosy can give rise, are found mentioned in Boeck and Danielsen's "Traité de la Spedalskhed" Christiania 1842 and Paris 1848; but although a long time has elapsed since this work was published, our acquaintance with the leprous diseases of the Eye is still very imperfect. Nothing collected has been given out on this subject; and, as a matter of course, the diseases of the Eye could not in that work be exhaustively described; especially as Ophthalmology has been developed more than any other branch of medical science, during the time which has elapsed since the publication of the work above-mentioned. The scanty notices here and there occurring in the journals shew only how little this subject has been investigated. That leprosy has been left entirely out of consideration in the Etiology of the diseases of the Eye, otherwise represented with sufficient minuteness, is so much the more remarkable, as there is no disease which so frequently gives rise to disorders of the Eye, as leprosy does; nor is leprosy in many countries — even if Norway is left out of consideration — a disease of very rare occurrence. A separate description of the diseases of the Eye which Leprosy may occasion can therefore not be regarded as superfluous and over-minute.

In the following description of the leprous diseases of the Eye, we distinguish between those affections which are the immediate expression of the leprous dyscrasis, and those which are only consequences of other leprous affections not primarily attacking the Eye or its Adnexa. The description will thereby gain in lucidity; although no systematic arrangement can be followed.

With regard to the nomenclature of the various forms of leprosy, we use only "tuberous" — i. e. Elephanthiasis or Lepra

tuberculosa, and "smooth", i. e. Eleph. or Lepra levis, in order to distinguish the two forms which are ordinarily well characterised by their respectively more or less serious course. As leprous affections of the nerves, with their inevitable Consequences Paralysis and Anæsthesis occur in both forms, the denomination "Anæsthesis" and "Anæsthetic" will be used to designate, not a particular form of leprosy, but the common consequential state of the leprous-nervous affections in both forms.

THE PROPER LEPROUS DISEASES OF THE EYE.

The leprous products may be spread over a greater surface in a thin layer, or they may be accumulated in larger masses in a more circumscribed area i. e. they may form tubers.

Nowhere can this be observed so plainly as in the Cornea, on which account we will here begin with the *Corneal affections.*

It is usual that the Cornea suffers in leprous patients; the ordinary manner in which it is attacked, is that a *superficial obscuration, proceeding from the margin diffuses itself over the Cornea.* This superficial obscuration occurs in most leprous patients, whether they suffer from the smooth form or the tuberous, but more frequently and demonstratively in the latter case.

The obscuration may shew itself in a very early stage of the disease. It usually occurs in both eyes at the same time, although more marked in the one eye than in the other. It begins ordinarily at the upper outer margin. The pellucid part of the Cornea forms, even in its normal state, a transverse ellipse, as the Limbus conjunctivalis above and below advances further over the Cornea than at the sides. Thus in cases of slight affection it appears as if this physiological condition were more marked than usual. But on closer examination with focal light — the patient looking strongly downwards, so that the parts near the edge may be brought over the dark pupil — the pathological peculiarity will easily be discovered, even with the slightest obscuration. It will then be seen that from the margin there proceeds a regular greyish obscuration not unlike a Gerontoxon

but with this difference, that no pellucid part appears between the Limbus conjunctivalis and the obscuration which here forms an immediate continuation of the Limbus.

Very often, particularly when an other magnifying lens is used, and even sometimes with the naked eye, it will be possible to discover fine vessels, which, as a continuation of the conjunctival and subconjunctival vessels, extend themselves over the corneal boundaries. These vessels often appear in so great abundance as to give to the whole obscuration especially at the margin a dirty reddish color (Fig. 1). They terminate in capillary points which, when sufficiently magnified, shew themselves surrounded by dull grey outlines. Where the vessel terminates, these outlines unite in one stripe advancing further towards the centre than the vessel, and giving to the central limit of the opacity a finely serrated boundary. With a magnifying glass one can nearly always discover in the margin of the obscuration, which to the naked eye appears quite even, small spots or points of a more opaque whitish color. Nearer to the centre of the Cornea, these spots appear further from each other; and with focal illumination they may be seen far within the more even peripheral obscuration, separated from it and from each other by entirely pellucid spaces. Yet the spots may in the whole of the obscured part be so close together, that the appearance to the naked eye may be as if fine flour had been blown in on the surface of the Cornea (Fig. 2). When they appear as more evidently separate spots (Fig. 1) they may be arranged in several series. The largest and most marked are always the most peripheral; the nearer to the centre, the smaller they are, until at last they disappear entirely. Sometimes we have been able to discover fine greyish stripes connecting several spots together; but as a rule it must be remarked that the spots are quite isolated, surrounded by clear spaces, and occur between the corneal centre and the more even, usually vascular, peripheral obscuration (with the fine greyish stripes which may form the continuation of it).

Although the superficial obscuration, as above stated, may shew itself in an early stage of the disease, yet its progress is usually very slow. We recognise here the same periodicity in the course, as characterises the whole disease. The state remains for years unchanged; then suddenly a Hyperæmia of the Cornea supervenes, during which the whole obscuration

may be overcast with vessels extending far over the Cornea. When the Hyperæmia has existed for some time, it goes back again, but leaves a greater obscuration. The more frequently the vascular injection occurs, the less completely it usually disappears; and in a more advanced stage, we have always found the obscuration also macroscopically covered with vessels. As the process advances, more and more of the Cornea becomes obscured; but it is an exceptional case when the whole Cornea is darkened in this manner. The centre usually remains free; but we have seen cases in which the whole surface of the Cornea had become opaque, and had the appearance of dull ground glass.

For *microscopic examination* we have procured some quite fresh preparations of the superficial corneal affection with the distinct spot-like obscurations, by cutting with a cataract-knife small superficial slices from the Cornea, and examined them in ½ % solution of chloride of soda. No permanent obscuration remained after this operation.

While in a successful preparation, no distinctly formed elements are discovered in those places where no obscuration occurs, such elements may be noticed under the normal epithelium which gradually becomes more and more distinctly perceptible — keeping the lower limits of the epithelium still well defined — in those places where the spot-like obscurations can macroscopically, or with the aid of a magnifying glass, be observed.

The elements which are here found together in groups are mostly quite small, of the size a white blood-globule and even less. In one case all the elements were slightly opaque; in another case the larger of them, of which some attained a considerable size, were finely granulated; and some had a slight brownish tint. In one preparation obtained some hours after death, all the elements had a strong yellow brown color (Fig. 3. Hartnack 7—3). This difference in color is evidently the expression of various age in the elements of the spots. The brown color, and the fine granulation always indicate the regressive metamorphosis of the elements in leprous products, when this metamorphosis takes place sufficiently slowly (G. A. Hansen Nord. med Archiv B. 1 No. 13 foreløbige Bidrag til Lepraens Characteristik og B. 11 No. 16 fortsatte Bidrag).

Where the obscuration is even, blood-vessels always appear

just under the epithelium; and elements like those described are accumulated principally along these vessels. Especially at the corneal edge, these cellular accumulations are usually so great that they become continuous; the nearer to the centre of the Cornea, the larger are the clear parts between the rows of cells situated on each side of the blood-vessels. Furthest inwards, several fascicles of vessels and closed pointed ends of vessels project into the pellucid part of the Cornea, without being accompanied by corresponding accumulations of cells, and without extending so far as to that zone in which the spot-like obscurations occur isolated (the latter may lie as much as abont 1 m. m. nearer the centre than the interior ends of vessels),

As the corneal cells cannot be distinguished in such fresh preparations, no information can be derived from them as to the genesis of the pathologically occurring cells. Attempts to color the excised pieces of the cornea with gold or silver have not been successful. But a Cornea taken out 5 hours after death has been successfully prepared with chloride of gold. It was first examined in a solution of chloride of soda; and the spots, as well as the rest of the obscuration, were found to consist almost exclusively of round corpuscles without any brownish color, and therefore on the whole of relatively young appearance. In the horizontal cuts of the gold colored Cornea, the large spots appear under the epithelium as dense accumulations of small round corpuscles of incomparably stronger color than the corneal cells. In these dense accumulations of round corpuscles, it is not possible to distinguish whether corneal cells are to be found among the round cells; none of the corneal cells could be isolated by picking them to pieces under the magnifying glass. But besides these large spots, places are occasionally noticed where a spot seems about to be formed. It may be seen as in Fig. 4 (which is drawn with 2 different focal adjustments and which therefore represents 2 different layers of corneal cells) that these last do not present themselves in their normal appearance and form. Their Protoplasma is quite blue-black. Their branches and anastomosing parts have mostly disappeared, and several small particles of the protoplasma are found detached from the rest. In other places a great many lymph-corpuscles are found on and between the altered corneal cells, The alterations of the corneal cells here described correspond entirely with those noticed in the traumatic Keratitis

in rabbits (Wiener med. Jahrbücher G. A. Hansen über die entzündliche Veränderungen der Hornhautkörperchen).

Where such alterations of the corneal cells occur in small round patches, it appears more probable that the round corpuscles which form the spot-like obscurations, are produced in loco, than that they should have immigrated, assembled themselves and halted on these places, as it were by appointment. Yet here and there we find in the preparations 2 or 3 of the round corpuscles together, which do not seem to stand in any relation to the corneal cells; as they are partly found imbedded in the corneal tissue between the branches of the cells; partly lying immediately on the latter, which do not exhibit the least abnormity in their appearance. Such dispersed round corpuscles are found as well in that part which might be called the spotty zone, inside the vascular part of the obscuration, as in the obscuration itself, in the clear spaces between the fascicles of vessels; and in the latter case they are not unfrequently accumulated around nervous fibres. Otherwise, the round corpuscles in this part are found, as before mentioned, in the greatest number along the blood-vessels, occurring the more frequently the nearer to the edge of the cornea. In the interstices between the fascicles of vessels, the corneal cells have everywhere their normal appearance; but along the vessels they occur mostly as fusiform cells with narrow oblong nucleus. They look as if they had been placed on edge by the imbedding of the vessels. Here are also found in no inconsiderable number the corneal cells altered as above described; so it may be in some degree probable that they have contributed actively to the formation of new cells.

The vascular part of the leprous obscuration appears in an anatomical point of view perfectly like that Pannus which can be produced in young rabbits by drawing a thread through the Globe in the region of the ciliar body, and cutting off both ends short, to prevent irritation of the cornea by direct contact with the thread. In successful cases i. e. when the superinduced Panophthalmitis progresses slowly, it requires 8 days to 3-weeks before a Pannus is devoloped; and the central part of the Cornea remains quite clear. Sometimes the formation of the Pannus will not take its course; and it must then be assisted by exciting a slight irritation in the centre of the Cornea. It will be superfluous to give a detailed description of a Pannus

thus induced. We shall only remark that the blood-vessels are more numerous, and lie closer together than in the leprous obscuration; and that proportionally more corneal cells are found altered in form, which may perhaps be attributed to, or considered as connected with, the more acute course of the disease.

It has not been possible to superinduce experimentally anything similar to the leprous spots on the Cornea.

According to the above data, and assisted by experiment, we may thus conclude that the corneal cells contribute actively to the formation of new cells, as well in the spots as in the Pannus-like obscuration. On the other hand it must be admitted that the great accumulation of cells in the Pannus-like obscuration is undoubtedly attributable to the migration of white blood-globules from the newly formed vessels; because the mass of altered corneal cells does not stand in any proportion whatever to the mass of new cells. A fact to which our attention should be directed is that, both in the leprous Pannus and in the Pannus superinduced in rabbits by artificial means above described, round cells are never found along the youngest outshoots and fascicles of vessels projecting furthest into the Cornea, excepting quite isolatedly here and there. Now the occurrence of the leprous spots still nearer to the centre of the Cornea indicates that they are to a certain extent independent of the immigration of the cells which accompanies the formation of the Pannus. A microscopic spot, as delineated in Fig. 3, gives the impression of having been produced by the division of a single corneal cell into small pieces, which have attained to further development before undergoing the regressive metamorphosis.*)

*) It might perhaps be objected that the corneal particle had fallen to pieces only in consequence of death; but this objection will scarcely hold good. In all the younger spots examined, all the pieces of protoplasma, large or small, have exhibited the usual appearance of living protoplasma. To connect our subject with the vexed question of the functions of the cellular tissue in inflammation, would carry us too far; as the object is only to represent facts for Leprosy. If I should refer to any literary publications, I should prefer to name Prof. Beale's works on cellular tissue and "germinative matter" (the microscope in medicine) which seem not to have been duly considered in the recent discussion on these subjects. I must also take occasion to defend myself against the assumption of Hoffmann (Vischows Archiv LIV. P. 508 Anm.) that in my preparations made at Vienna I have had before me a "mixtum compositum" of fixed and migratory cells. I must deny that any such inference can be

There can scarcely be any question of *treating* the superficial corneal obscuration; as the sight is not much impaired by it; because the obscuration very rarely extends to the centre, In the few cases where it might threaten to cover the centre, the excision of a circular bridge from the Conjunctiva round the corneal margin ought perhaps to be attempted. The successful result which can be attained by this operation in cases of Pannus otherwise caused, might perhaps justify such an attempt; and the more so as it may be assumed from the clinical course, and from the microscopic investigations, that the development of vessels plays the most important part in the formation of the superficial obscuration. Abrasio Corneæ to any great extent would be a hazardous experiment, especially as it would only be attempted when the spots had reached the centre; in which case the whole eye would usually have suffered so much, that no favorable result could be expected.

The Cornea is attacked in a more remarkable manner, although relatively less frequently, by a *tuberous growth* on its surface, or in the substance itself.

As the tuber is only a deposit of leprous products in a more circumscribed area, it follows naturally that there is an imperceptible transition from the superficial corneal obscuration to the formation of tubers; especially as a smooth obscuration of the corneal surface always precedes the tuber, at least when the latter developes itself in the superficial layers.

If the tubers are developed on the surface of the Cornea, as most usually they are, they always begin, in analogy with other new formations, at the corneal margin; and like the corneal obscurations, in the great majority of cases, on the outer part. Quite exceptionally we have seen them form

drawn from an unprejudiced consideration of my drawings in Wiener med. Jahrbücher; Mr. Hoffmann's assumption becomes therefore a doubt as to the accuracy of my drawings. I do not think that a criticism on preparations and drawings derived from the Cornea of rabbits is of any avail, when the criticism is based on preparations of other organs of the same animal, or of frogs; nor even if based on preparations of the same organ, when the latter is not as far as possible prepared in the same manner; but I venture to predict that the experiment would in future be more fruitful if conducted with a view to discover under what circumstances the fixed cells are excited to greater vitality, and under what circumstances they are not so. In the mean time, according to other authors and to my own experience, I presume that extreme cases will occur even in this respect.

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themselves near the inner margin. Usually both eyes are attacked; and in that case, as a rule, the tubers occur symmetrically on the corresponding quadrants of the Cornea.

The first sign of the development of tubers shews itself by a circumscribed injection close to the corneal margin. The injection is of a triangular form (Fig. 5) with its base turned towards the Cornea, and the apex outwards. We observe both much enlarged and tortuous conjunctival vessels, and distended episcleral vasa appearing through the Conjunctiva with a violet hue. Their anastomosis with the conjunctival vessels appears often with remarkable distinctness. Very early — before the development of any distinct tuber — the Cornea near the injected part begins to be obscured; and this obscuration is not in any respect distinguishable from the superficial corneal obscuration before described. It is remarkable that the obscuration is always, both in the first stage of tuberous development and in the fully developed tuber, most marked at a little distance from the tuber, and separated from it by a more pellucid belt (Fig. 6 & 7). In the superficial obscuration vessels, and not unfrequently large vessels, will in most cases, also with the naked eye, be observed extending far over the surface of the Cornea (Fig. 8).

When the Hyperæmia has existed for some time, a yellowish red somewhat elevated spot begins to form itself, and, as it increases in size, spreads itself over the corneal margin (Fig. 6 & 7). While the swelling on the outer side is evenly inclined, on the inner side towards the centre of the Cornea it is abruptly terminated and sometimes overhanging. As the tuber grows, it acquires a more uneven surface, and extends further and further over the Cornea, covering it sometimes at last entirely. It may increase so much in volume as to prevent the closing of the Palpebræ (Fig. 9). After having existed for a shorter or a longer time, and often for years unchanged, it begins to be absorbed, or in rarer cases to disappear by ulceration. Together with the tuber, the globe will also usually shrink considerably (Fig. 10).

If the development of the tuber takes place in the profound layers of the Cornea, focal illumination will shew how a thinner or thicker layer of the Cornea lies in front of the tuberous mass. The tuber may lie so far back that, especially in the early stage, it may be difficult to decide whether it has its seat in

the Iris, or in the posterior lamellæ of the Cornea. We have not always been able to discern macroscopically any obscuration of the corneal substance in front of the deeply situated tuber. The tuber advances with rather sharply defined ontline, like a wedge between the lamellæ. Its color is less red, but usually more greyish than that of the superficial tuber. The development of tubers often takes place sumultaneously in the same eye, both on the surface of the Cornea and in its profound layers.

Anatomy. As appears from the clinical description, there exist superficial and profound tubers. The ways by which the tubers grow into the Cornea may be seen from Fig. 11, which is a somewhat schematised delineation composed according to several cuts of the same eye. It may be seen from this delineation that the more superficial tubers take their origin from an episcleral formation; and from this they may either advance right under the corneal epithelium, sometimes leaving nearly all the posterior part of the Cornea pellucid, even if the whole surface of the Cornea should be covered by the tuber, or the episcleral tuber is continued along the vessels which extend into the Sclera towards the middle of the thickness of the Cornea, and thence grows like a wedge into the latter, leaving both the anterior and posterior part of the Cornea pellucid. Above the episcleral part of the tuber, the Conjunctiva is usually very easily movable. Only when the tuber grows very rapidly, the submucous tissue becomes also infiltered; so that the epithelium rests immediately on the tuber.

The most deeply situated tubers proceed from the region round about the Canalis Schlemmii, and advance into the Cornea immediately in front of the Membrana Descemeti; the space between the fibres of the lig. pectinatum iridis are also constantly and densely filled with round corpuscles.

The obscuration advancing before the tuber, which with the naked eye is most easily seen when the tuber is superficial, and which can always be observed microscopically in cases of deep corneal tubers, corresponds in every way to the leprous Pannus just described. In microscopic preparations it appears, still more distinctly than in clinical examination, that when the tuberous development proceeds from the surface, the layer of round cells which lies immediately before the tuber is thinner than that situated a little nearer to the centre of the Cornea

(Fig. 12). The tuber is formed only by a further development of the alteration occurring in the superficial obscuration; new vessels being formed, while accumulations of round cells about the vessels increase in number until they become continuous; whereby the basal substance of the Cornea is left like a net of anastomosing filaments, in the more or less close meshes of which the round cells lie accumulated — as is the case in other granulated cell-growths (Granulationsgeschwülste, Virchow).

The peculiarity of the leprous tuber arises partly from its moderate number of vessels, which although rather wide, and constructed like capillary vasa, are only when in a state of strong repletion, capable of communicating to the tuber a decided red color. The interstices between the vessels are large; and the surrounding cellular mass is compact. The essential peculiarity of the tubers is in the form of their regressive metamorphosis. The latter always commences at or near the centre of the tuber, where a softer part appears, increasing steadily in extent, and also by its form sharply distinguishing itself from the surrounding parts. While the cut surface of the bloodless tuber is brilliantly white, and has a humid lustre, the softer part has always a more or less intense yellow-brown color, and is always without lustre. The succulence can be somewhat various. The contents cannot usually be called either dry or humid; if a piece be taken on the knife, and placed on an object-glass, it appears like a finely granulated mass, with so little serum, that a small quantity of liquid must be added in order to float the granules. Only seldom are the contents a more or less dense liquid; and only in old shrunken tubers a dry detritus.

The elements in the softened part are almost exclusively brown and brownish yellow bodies of extremely different form and size (Fig. 13, shews such elements taken from cutaneous tubers, corresponding perfectly to those which are found in the Cornea, and not there only, but also in other leprously affected parts of the eye, in the spleen, liver, lymphatic glands, testicles and nerves, as result of regressive metamorphosis of the elements). Not seldom there occur also large Myeloplaque-like cells, with contents of even or patchy brown color. Like other regressive elements the contents of these cells cannot be colored with carmine. Moreover regressive elements which by

their form establish their origin from the corneal cells*) are always to be found in the softened part (Fig. 14).

A few words more concerning the corneal cells in the tubers. In the obscuration which advances before the tubers the observed phenomena are the same as in the leprous Pannus, above described. In the tuber there can always without much difficulty be discerned a considerable number of unchanged corneal cells, as well in young (Fig. 15) as in old tubers; as well in the younger, as in the older parts of the same tuber. They are always distinguishable from the round cells; not only by the form, but also by their being more slightly colorable with carmine than the latter. It is therefore probable that by far the greatest number of the cells which form the tuber may be attributed to immigration. This is still further corroborated by what can be found in the middle of the softened part. The blood-vessels are here at last obliterated, but may however for a long time retain a fresh appearance; along such vessels, which run among exclusively regressivy elements that cannot be considered productive, rows of round corpuscles are to be found of very peculiar appearance, and which eagerly imbibe carmine. These cells cannot well have come from any other place than from the blood-vessels. It can be clinically shewn that a tuber may also grow long after the commencement of the softening; and the above mentioned observed phenomenon seems to shew that new parts are even produced in the midst of the oldest parts. Cells with many nuclei are only found in the older parts of the tuber; scarcely ever in the growing advancing fresh border, where on the other hand there are always found small particles of germinativ matter without any nucleus, This observation does not give much support to the opinion that division of the nucleus is an introductory step to division

*) With respect to the relation of these elements to the Chemical agencies, I must refer to Nord. Med. Archiv. No explanation can be given of the cause of this peculiar coloring. From Fig. 3, and from the description, it appears that this color is also found in the elements which lie so near the centre of the Cornea that they cannot be held to stand in any intimate connection with blood-vessels. The explanation (tentavely put forth in the Nord. med. Archiv) of the color, as derived from the blood, can scarcely hold good here. It seems really as if the color was attributable to something which had been imported, when that part of the Cornea became leprously affected. It must however be remembered that cases of acute softening occur, in which this color is not found.

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of the cells in these affections; even if reproduction of cells can ever take place by a simple division.

When the corneal tuber, in rare cases, ulcerates, this can, as with cutaneous tuber, take place in 2 manners. Either firstly, the softened tur bebreaks up, and forms a crater-like ulcer, at the bottom of which the Membr. Descemeti can protrude; or secondly, in superficial tubers (in which the epithelium is always very hypertrophic with beautiful "Riffzellen"), there may occur a constant epithelial sloughing, and exposure of the substance of the tuber, on larger or smaller spots.

The development of tubers on, or in the Cornea is far more dangerons for the sight than the superficial corneal obscuration; and these tubers are (with the tubers on the Iris) perhaps the affections which blind the greatest percentage of leprous patients. In any case very little can usually be done to prevent their growth, which is destructive to the eye.

Where as yet only episcleral infiltration has existed, where the tubre is just beginning to encroach on the Cornea, it has occasionally been possible to prevent further progress, for a time, by energetic cautery applied along the corneal margin. In order to obtain any result, the cautery must penetrate so deeply that all, not only the conjunctival, but also the submucous, vessels are destroyed by it. Wounds from cautery heal easily, and are usually not attended with much inconvenience to the eye. If the tuber has grown to any size, all treatment is fruitless. It has repeatedly been attempted to excise parts of the tubers, and cauterise the surface of the wound with nitrate of silver; but the results of the operation have not been encouraging; as the tubers have grown uninterruptedly. The only thing to be done when the tubers are so far advanced in growth that they begin to cover the pupil, which is frequently fixed by films of exudation, is to make a coremorphosis behind the most pellucid part of the Cornea. The operation has no influence on the growth of the tuber, and can only be considered as a palliative. Against the development of tubers in the profound layers of the Cornea, we are completely powerless; operations have been repeatedly attempted but without avail.

Before leaving the corneal affections, we must devote a few words to a brief mention of a form of Keratitis which, without being regarded as properly leprous, is often found as well in the tuberous, as in the smooth form of leprosy, but most frequently in the tuberous form, namely, Keratitis punctata.

It occurs in leprosy — in the same manner as when occasioned by other dyscrases (for instance Syphilis) — complicated with Iritis; and shews itself by numerous minute punctate deposits of lymph, of brown or greyish hue. These are at first sharply defined, and usually in the lower half of the Cornea; but they may also appear over the whole Cornea. The part attacked has often the form of a sector (Fig. 16); but sometimes only the centre is attacked. By focal light it may clearly be seen that the punctate deposits lie in the various layers of the Cornea as if small grains of sand had been baked into its substance*).

*) That the centre alone may be found attacked, while the marginal parts are pellucid, and that the punctate deposits, where the disease is typical, occur from the beginning in the various strata of the Cornea, seems to me to tell against the accurary of the notion that the point-like Phoci are secondary and occasioned by an Iritis. Many authors have effaced the Keratitis punctata as a peculiar form of Keratitis; and have adopted names which appeared better fitted to express the nature of the disease; such as Keratoiritis. Hydromeningitis, Aquocapsulitis. It was supposed that an Iritis (especially a serous Iritis) would first make the aqueous humor turbid; and that afterwards punctiform precipiates might have been deposited on the posterior surface of the Tunica Descemeti. This, it was suggested might explain why the lower half of the Cornea is attacked. Of course I am far from intending to deny that such forms of Iritis occur; having myself often had occasion to see them; and for these cases one of the above mentioned denomination may be suitable; but that such precipitates on the posterior surface of the Tunica Descemeti should be able to produce punctiform Phoci in the various layers of the Cornea I do not believe. A precipitate on the posterior surface of the Tunica Descemeti may be supposed to produce an opacity of that part of the Cornea which lies just before the precipitate, as in the case of a partial cataract produced by a precipitate on the anterior capsule of the lens; but that the punctiform precipitates on the posterior surface of the Tunica Descemeti should be able to penetrate through it into the various layers of the Cornea, appears to me inconsistent with the microscopic structure of the latter. Moreover the punctate deposits could not in that case occur simultaneously in the superficial and profound layers; and the lower parts of the Cornea could scarcely anywhere remain pellucid.

That the punctate deposits in the real Keratitis punctata are most frequently found in the lower half, can no more be explained than that the upper half of the Cornea is first and chiefly attacked by the leprous superficial obscuration. I think that, without becoming guilty of particularistic

When these punctated deposits have existed for a shorter or longer time, an ill-defined opaque halo begins to form around them; they become less distinct; so that the Cornea appears more evenly obscured. After a time the Cornea may again become pellucid, the spots entirely disappear, and the disease terminate without any treatment, and without leaving any trace. On the other hand we have also seen the spots remaining for years without alteration.

Apart from any circumscribed or more diffuse infiltration of the submucous tissue, which precedes and accompanies the development of the superficial corneal tubers the *Sclera* is scarcely affected independently by leprosy. That the Sclera takes a yellowish dirty color, has from old times been regarded as one of the earliest signs of leprosy. This discoloration however has probably no other source than the chronic Hyperæmia consequent on the formation of episcleral tubers.

We have often found that the Sclera round about the corneal margin assumes a hyaline appearance; and that in the tissue there lie imbedded pellucid granules, like frog's spawn. On applying pressure with a pointed body, the indentation produced remains for a long time. It seems as if the submucosa were infiltrated with serum. The sensitiveness around the Cornea (not on the Cornea itself), becomes at the same time more obtuse.

A dark blueish color of the Sclera, extending to the width of a few lines round the Cornea, is also not seldom to be noticed in older leprous patients (Fig. 17).

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tendencies, one may safely set down the Keratitis punctata as a special corneal affection. That in most cases it occurs complicated with Iritis, is no sufficient reason for abolishing it as a particular form. Diseases, as we all know; usually occur uncomplicated in books only; and if we should consider as special forms only those Keraticis which occur pure, their number would not be "legion". I have, moreover, seen in a syphilitic case a Keratitis punctata, not indeed much developed, but still with distinct dots; and there neither was, nor did there afterwards appear, any trace of Iritis.

Ole Bull.

The affections of the *Iris* deserve the greatest attention. Here also leprosy deposits its products either more evenly or in tubers. The former is incomparably the most frequent occurrence. If we examine a somewhat large number of leprous patients, we shall find in 30 pr. cent, traces of Iritis, in the form of fringes round the pupillary margin, or of deposits on the capsule of the Lens.

Iritis occurs about as frequently in cases of tuberous leprosy as in smooth; in the latter form however, the Iritis, in the majority of cases, must not be regarded as an immediate consequence of the leprous Dyscrasis, but as the result of a corneal ulceration occasioned by a paralysis of the M. orbicularis. That such in the case may be deduced from the facts: that Iritis usually occurs late in the smooth form of leprosy; that it most frequently attacks the eye which has suffered most from paralysis, and is found together with corneal ulceration or traces of it. While, in the tuberous form of leprosy, the Iritis may occur as early as in the first year after the disease broke out we have never found any Iritis in the smooth form, until 8 or 10 years after. Nevertheless in cases of smooth leprosy, we now and then meet with an Iritis, or traces of it, which must be considered as a product of the dyscrasis, and not occasioned by any external noxa. When we see, in this form, an Iritis occurring without any paralysis, or where the latter is only incipient and without any trace of ulceration being discoverable on the Cornea, we must conclude that the cause is to be sought in the dyscrasis.

As the clinical image is quite identical, whether the Iritis is a product of the dyscrasis or of external *noxa*, it is in practice often impossible to lay down any diagnosis; especially as the 2 forms of disease, the tuberous and the smooth, are often mixed and go over one into the other. Thus if, in a patient who has formerly suffered from the tuberous form, but now exhibits the image of the smooth form, there are found traces of an Iritis, it is not possible to decide, whether these traces are attributable to a former stage of the disease or not. The differential diagnosis must therefore be left to microscopic investigation. Only so much we can establish by clinical examination: *Iritis produced by leprous dyscrasis occurs very often in those who suffer from the tuberous form, and also exceptionally with the smooth form.*

The course of Iritis is partly chronic, and partly acute. As chronic Iritis occurs without violent symptoms, it is not uncommon to find exudations around the borders of the pupils, and adhesions to the capsule of the lens, in patients who have not complained of pain or derangement of sight. More acute Iritis is usually attended with pain, and often severe pains, pericorneal injection, and diminished power of vision. If the patient is examined during, or shortly after, such an attack, it will nearly always be found that the corpus vitreum is obscured. This obscuration and the consequent derangement of sight, often remain for a long time unchanged; but after the lapse of some month they usually disappear; and they may disappear without leaving any trace. But if there have been repeated acute attacks, traces of this obscuration of the vitreous body will usually be discovered of by ophthalmoscopical examination in the form of numerous black shreds whirling round each other when the eye moves.

The obscuration of the corpus vitreum, observed during the more acute inflammations, shews that the corpus ciliare and choroidea suffer also. Such inflammations are therefore to be considered as Iridocyclites or Iridochoroidites. We have however not yet found circumscribed atrophies, pigmentary spots, nor any thing like remnants of circumscribed or diffuse Choroiditis in patients who have frequently suffered from acute Iritis. On the other hand we have often seen that there has remained a light greyish obscuration of the parts of the retina which surround the optic disc, with a relative tennity of the retinal arteries. We have noticed in these cases a considerable diminution in the power of vision, even if there has not been any synechia nor deposit on the anterior capsule of the lens.

Iritis occurs, as might be expected where originally caused by a dyscrasis, in the great majority of cases in both eyes.

Development of tubers in the Iris is not so common as in or on the Cornea. Tubers in the Iris are not seldom complicated with corneal tubers (Fig. 18). The tuber always proceeds from the periphery, and most frequently in the lower half. When we have observed tubers in the Iris, there have always been traces of Iritis at the same time. Macroscopically the Iris-tubers appear to have a more even surface than the corneal tubers, and the color is, like that of the deep corneal tubers, more greyish. When the tubers are developed below the pupil

they have a striking likeness to a hypopyon. They may occupy the greater part of the periphery of the Iris, and grow so as at last to fill up the whole of the camera anterior. Not unfrequently the region above the corpus ciliare becomes partially staphylomatous, while the tuber in the Iris is developed. It appears reasonable to explain the production of these staphylomata from the anatomy of the part. Those parts of the Sclera which lie above the region of the corpus ciliare, are in their normal state traversed by numerons vessels; the vessels of the Choroid and the Iris anastomosing there with the conjunctival and submucose vessels. The resisting power of the Sclera is moreover weakened; as the canalis Schlemmii lies here imbedded in it. If now there occurs a pathological development of vessels, or an enlargement of those previously existing (and this always takes place in the development of tubers) the Sclera becomes not firm enough to resist the intraocular pressure; and the result is a partial staphyloma corporis ciliaris on the place corresponding to the tuber.

The anatomical changes in the Iridocyclites and the formation of tubers in the Iris, are in all essential points the same as in the formation of tubers in the Cornea.

In the Iridocyclites there is an even infiltration of round cells in the Iris, processus ciliares, musculus ciliaris, choroidea and membrana suprachoroidea as far as the ora serrata or a little further backward. As places where the infiltration is always especially strong, we remark the fascicles of cellular tissue between the sphincter and dilatator pupillæ*); the spaces between the filaments of lig. pectinatum Iridis; the spaces between the veins coming from the processus ciliares, and the part of the membrana suprachoroidea lying between the Sclera and the musc. ciliar. Also the trunks and the branches of the ciliary nerves are more or less strongly infiltrated with

*) As dilatator pupillæ it is comparatively easy in the human eye to exhibit the membrane described by Henle in his "Anatomie" and delineated in Fig. 485, lying before the Uvea on the posterior surface of the Iris. With careful treatment of preparations that have lain 8 – 14 days in Müllers fluid, and with the help of a needle, it is possible to isolate large parts of this membrane; and by careful preparation (with the help of a pencil) to exhibit them quite free from pigment. The membrane then appears formed of a single layer of closely-lying long fusiform cells partly furcated, divided and with long fusiform nuclei, in no way differing from the cells which form the sphincter.

round cells, whereby the medullary vaginæ of the nervous filaments mostly disappear; while the axial cylinders, although often compressed (Fig. 19 a) are seldom quite brought into a state of atrophy by the pressure of the imbedded cells, so as to leave empty vaginæ (Fig. 19 b).

These infiltrations of the corpus ciliare are always found where external Episcleritis exists, even in the slightest degree.

If the infiltration is very strong, there are always found between the filaments of lig. pect. Iridis new bloodvessels which also project some distance before the memb. Descemeti. By a further development of these, the tubers in the Iris are formed, always proceeding from this part in front of the musc. ciliaris, pushing before them the anterior limiting membrane of the Iris (Fig. 20). In the normal state this membrane consists of a dense felt of stelliform cells, which lie in, or on, an extremely fine elastic membrane (Fig. 21). During the formation of the tuber the membrane becomes thickened, so that it can easily be prepared out in large pieces; and in these pieces the original cells are found very considerably compressed, apparently without having had any part in the construction of the tuber (Fig. 22).

It is also easy now to demonstrate by these infiltrations that many of the preexisting normal cells remain unaltered even in the interior of large Iris-tubers (Fig. 23). In the membrana suprachoroidea, we find the large pigmented and unpigmented cells together with large oblong nuclei (which by Schwalbe are considered as nuclei in an endothelium covering the perichoroideal lymphoid cavity), in perfectly normal arrangement, and with a normal appearance. Only exceptionally we meet with cells which by their form indicate a derivation from the stroma-cells in the Iris and membrana suprachoroidea, and which by their more granular protoplasma (strongly colorable with carmine unlike the other stroma-cells) seem to have been possibly in active operation. We also frequently find here, as in the Cornea, small masses of protoplasma without any nuclei and not in connexion with the larger cells. In the densely infiltrated ciliary nerves we find nuclei in the Schwannian vaginæ with unaltered appearance (Fig. 19). The elements undergo here also the regressive metamorphosis at last; whereby the same forms and the same color become noticeable as above described in the corneal affections. These regressive elements may still be found years after the acute phenomena have disappeared.

As we have not unfrequently found the muscul. ciliaris densely infiltered with round cells, even when the eye had macroscopically a normal appearance, we have thought that it might perhaps be clinically demonstrable, by examination of the amplitude of accommodation which in that case would probably be diminished.

It must here be remarked that it is not easy to find suitable subjects for such investigations; partly because the eyes of leprous patients are affected in so many ways; partly because many patients are so debilitated by the disease, that the ordinary marasmus forms a sufficient explanation of a possible diminution in the range of accommodation. The investigations which we have hitherto made with carefully selected subjects, have however given a negative result: the amplitude of accommodation has not been less than normal.

The treatment of Iritis or Iridocyclitis is not so hopeless as for diseases of the Cornea. The chief point is of course in this case (as always in cases of Iritis) to prevent Synechia by timely instillation of Atropine. As Iritis occurs so usually in leprous cases, patients should always be exhorted to apply immediately for medical aid, as soon as they notice any diminution of the sight, pain or redness in the eye. Many cases of Amaurosis, which now make the sad fate of these unhappy patients doubly grievous, might have been prevented, if the patient had had the benefit of judicious treatment in good time, before the occlusion of the pupil and its sad consequences were too far advanced.

Atropine must be applied energetically and frequently for a very long time; and if the pains and the injection do not diminish, it must be assisted by injection of morphine, application of leeches &c. In most cases it is possible by consistent treatment to prevent any injurious consequences of Iritis. In the many neglected cases brought to the hospitals, it is necessary to have recourse to Iridectomy, in order if possible to restore a little sight to the patient, and prevent the injurious consequences of an occluded pupil.

As to the treatment of tubers in the Iris, there is nothing to be done, but to make an Iriditomy, and thereby remove the tuber, with the part of the Iris which it occupies.

Of the leprous *Retinal affections*, there is clinically little to be said; as they develop themselves in a place which cannot be examined with the ophthalmoscope. In any case we have, after careful ophthalmoscopical examination of more than 200 patients, not yet been able to discover in the fundus oculi any pathological alterations which could be attributed to leprosy.

It must however be remarked, judging from post mortem examination, that the retinal affections begin in the anterior part of the retina, and as the disease progresses, they extend further and further in the posterior direction. In those cases where diseases of the eye are most advanced, and where consequently it might be expected that something could be discerned by the ophthalmoscope, the ophthalmoscopic examination is frequently rendered impossible by obscuration, and development of tubers in the Cornea. Judging from what may be seen macroscopically by autopsy, the leprous retinal affection should shew itself in the peripheral parts of the fundus oculi, in the form of greyish white points or spots (Fig. 24). As the affection has its seat far out in the periphery, it produces no subjective phenomena.

As hitherto we have found the retinal affection only in cases where the corpus ciliare and the Iris have been strongly infiltrated with round cells, it seems that we may consider it as a secondary affection. Until now there has only been opportunity to see it in its regressive stage. It does not extend more than 3—4 m. m. behind the ora serrata; and the regressive elements most frequently lie meridionally arranged.

On cutting an osmium-preparation of such of retina, the regressive elements, strongly colored by the osmium from brown to black, were found as well in the exterior and interior granulous layers, as in the continuations of the radial fibres, which here run horizontally (Fig. 25). In "isolated preparations" (Isolations Preparaten) they were found numerously imbedded in, or attached to the latter, and this was the case in the whole space between the limitans externa to the interna (Fig. 26).

Leprous affections of the Adnexa of the eye. Probably the leprous products do nowhere deposit themselves so frequently

as on the *Supercilia*. This takes place in so early a stage of the disease, that the falling off of the eye-brows is a good pathognomonic symptom of leprosy. This however is without influence on the organs of sight.

On the other hand the affections of the *Palpebræ* are of essential importance in such respect. These affections may be divided into 2 groups: diseases which occasion a change in the *shape of the eye-lids*, and diseases which produce a change in *their position*. Generally speaking the first belong to the tuberous form, and the last to the smooth. We shall here only concern ourselves with the first, as being properly leprous affections.

The change of form is brought about by development of cutaneous tubers. The falling of the eye-lashes is usually the first symptom of tuberous formation; afterwards the tubers appear manifest to the touch and to the sight. As they grow, the skin over them often assumes a dirty brownish color. They may attain to the size of a hazel-nut, and become a mechanical impediment to the free movement of the Palpebræ. They may again disappear, either by ulceration from the surface (and this is most usual) or by softening from the centre. Very seldom they are exhausted, simultaneously with the other cataneous tubers, by suppuration; small abscesses forming themselves.

If the tubers retire in the usual manner, a cicatrix is sometimes formed, which in shrinking may cause an ectropium organicum in the upper or lower eye-lid. Excepting the consequences of these rather rare ectropia, the development of tubers in the Palpebræ does not seem to exercise any injurious influence on the organs of sight. We may thus (Fig. 27) find Palpebræ in a high degree mis-shapen, with large tubers, indented borders, and without trace of eye-lashes, and yet not be able to discover any pathological change in the globe itself.

The construction of tubers in the Palpebræ is like that of other cutaneous tubers; and they lie subcutant or in the cutis itself, whereby the corpus papillare may be involved in the affection. The infiltration of cells in the cellular tissue always begins along the blood-vessels; and only little by little they become so large that they coalesce; of the original cellular tissue, there then remains, as in the Cornea, only a framework in which the cells lie imbedded (Fig. 24). The epithelium in the hair-follicles, in the sebaceous and in the perspiratory

glands, becomes strongly hypertrophic in the commencement of the formation of tubers; and it is probably owing to the pressure of the hypertrophic epithelium, that the hairs fall out: for we find usually the most hypertrophic follicles without hair. Afterwards the hairfollicles and the glands are reduced again to a state of atrophy by the pressure of the accumulated round cells in the tuber. When the corpus papillare also is infiltrated, the epidermis becomes hypertrophic; and little by little the external layer is repelled, without the repelling cells becoming dried. At last it becomes covered only with stratum Malpighi formed by enormously enlarged cells, and whereby the superficial ulceration of the tuber is induced. The softening begins here, as in other cases, at the base, or in the middle of the tuber.

The treatment is simply extirpation of the tubers, when by their position or size they inconvenience the patient.

As to the diseases of the *Conjunctiva* we have, in the description of the corneal tubers, already mentioned a circumscribed conjunctival and submucous injection preceding the formation of superficial tubers. We have there also mentioned that it is only in cases where the tuber grows rapidly, that the conjunctiva becomes infiltrated; usually it may be seen, from the conjunctival vessels being easily movable over the episcleral tuber, that the conjunctiva itself is not attached to it. Otherwise we have not found that the conjunctiva is independently attacked by the leprous dyscrasis.

SECONDARY RESULTS OF LEPROSY.

Among the various consequences of leprosy, there is one of the greatest importance for the organs of sight; and that is *the paralysis of those ramifications of the nervus facialis which innervate the M. orbicularis palpebrarum.*

The paralysis of the orbicularis occurs usually in a greater or less degree in all those patients who, (whether they have suffered from the tuberous or the smooth form of leprosy), have become

anæsthetic, by a greater or less number of the peripheral nerves having been so strongly affected, that either as a direct consequence of the leprous affection, or as a consequence of a consecutive chronic inflammation, a great number of the nervous fibres of the trunks attacked are reduced to a state of atrophy by pressure (vide Auspitz & Pick: Archiv für Dermatologie und Syphilis 1871, zur Pathologie der Lepra von Dr. G. A. Hansen).

This applies to affections of N. facialis, where it bends round the Maxilla, with the consequent paralysis of the muscles of the face. The paralysis is never complete, and often affects the different muscles in various degrees.

The paralysis usually progresses very slowly; so that many years may elapse between the time when the slight quivering of the palpebra inf. on closing the eye, indicates the incipient paresis and the time when a complete ectropium paralyticum is produced.

The paralysis does not always reach all the fibres of the muscle. As that half of the muscle which lies on the nasal or on the temporal side is specially paralised, the ectropium is found more developed inwards (which is most usual) or outwards. And it is not rare that the outer or inner half of the tarsal border fits closely to the globe, while the other is quite deranged. It follows of course that when the parlysis has produced an ectropium paralyticum; it occasions many pathological alterations of the palpebræ and globe, such as elongation and, secondarily, shrinking of the tarsus inf; hyperæmia of the conjunctiva tarsi & bulbi; keratitis with formation of pannus and ulceration and, secondarily, bulging of the Cornea and of the adjoining part of the Sclera, Iritis &c. But all these affections are entirely without that typical course which distinguishes the proper leprous affections. With regard to the corneal affections, the regular constantly recurring arrangement of vessels and round cells is wanting; here and there in the lower periphery a vessel projects over the corneal border; and the accumulation of cells which form the obscurations are found irregularly diffused over the lower part of the Cornea. The regressive elements never appear with the characteristic brown color, nor with their manifold shapes, as in the proper leprous formations.

A more particular description of these affections may therefore be omitted, as not properly applicable to leprosy. We will only remark that the pathologigal alterations which may be

attributable to the ectropium are not produced more rapidly in lepers than in cases where the ectropium depends on other causes. Especially in the Cornea, we have not found any pathological alteration which has not had its sufficient explanation from the influence of external noxa on the eye exposed by the ectropium; so that the "neuroparalytic keratitis" mentioned by some authours, said to be found in the smooth (anæsthetic) form of leprosy, does not probably exist.

The neuroparalytic form of keratitis occurs seldom without a complete paralysis of the first branch of the quintus, or of those branches of it which supply the Cornea with sensitive nerves. Now certainly a partial paralysis of the first branch of the quintus is not rare in leprosy; but the paralysis affects more those branches which extend to the exterior skin, chiefly the supraorbitalis, and scarcely ever that branch which extends to the ganglion ciliare, and from which the Cornea is supplied with sensitive fibres; in any case we have never observed anæsthesis of the Cornea. We have indeed often found slight or scarcely perceptible pathological alterations in the globe, in cases where the paralysis has lasted for many years.

It is also quite remarkable that the cananiculi lachrymales should keep open so long. We have found them easily permeable for a rather thick probe, in cases where a complete ectropium has existed for 10—15 years. It is however in such cases attended with some difficulty to find the orifice; as the punct. lacrymal. is covered with dry secretion, and is also somewhat contracted.

The consequences of the paralysis may indeed for the most part be prevented by judicious treatment. As a prophylactic in the beginning of the paralysis, the wearing of protecting spectacles may be indicated; and if from any cause an inflammation should arise, then the closing of the eye for a time. As however the whole process has a chronic course, perseverance is in the highest degree necessary. A very early operation before ascertaining that the paralysis has not increased for a long time, is not to be recommended. The paralysis in most cases becomes almost total (even in the worst cases the lid may be moved a little) and if therefore as soon as it begins to shew itself, an operation is attempted, it will after a time be insufficient to prevent the ectropium. On the other hand we cannot wait until the process has run its course; as this may

take many years; and in most cases the eye would have suffered so much that there would be little left to save. We have often attempted to perform tarsoraphy according to the usual (Græphe's) method, but without much success; the canthus internus has always subsequently receded from the globe; flowing of tears over the cheek &c. resulted, and the operation has after the lapse of some time proved to be insufficient. We have obtained far bettter results by sewing up the whole canthus internus as far as the punctum lacrymale. This operation has been, in the course of the last few years, performed in a considerable number of cases, and always with a good result. The modus operandi is as follows: The fixed border of the eye-lid is pierced with a Beer's knife just inside of the punct. lacrymale, and so superficially that the cananiculus lacrymalis is not touched. With a sawing movement of the knife the border in loosened as far inwards as possible, after which the bridge of skin still attached to the punctum lacry. is cut through. In the same manner the border of the upper eyelid is prepared; and the preparation is completed with the scizzors furthest inwards in the corner, where it is difficult to apply the knife. The bleeding may be considerable, especially if in large carunculi lacrymales it is neccessary to cut off a part of these. The bleeding borders are then connected with 2 suturæ nodosæ, which are carried through the palpebræ, so far from the border that they do not touch the cananiculi. It is most important that the suture which connects both the puncta lacrymalia together be accurately adjusted. The wound is left uncovered. The healing has been in every way good: the sutures have been removed on the 3rd or the 4th day.

The puncta lacrymalia and the cananiculi are thus left free in this operation; and the lower punctum, before everted, is brought into contact with the globe (Fig. 28: a. Pat. before: b. after the operation).

Experience shows that the functions of the lacrymatory ducts are in many cases reestablished by the operation; for where flow of tears formerly occurred, this subsequently ceases. Where the ectropium has only or chiefly affected the interior part of the eye-lid, this operation has proved sufficient to bring the whole border of the eye-lid into complete or nearly complete contact with the globe. When on the other hand the whole eye-lid has been attacked by the Ectropium, it has been found

neccessary to connect a tarsoraphy with the operation; and if the whole eye-lid has been for a long time entirely reversed, and the skin of the cheek has been considerably retracted, an incision must still further be made and the skin partially transplanted in order to get the eye-lid raised. If the result under such circumstances has not always been completely satisfactory, still it has always been improvement in a greater or less degree. If the object is attained to bring the punctum lacrymale and the border of the eye-lid into contact with the globe, then hyperæmia which may have existed for years and have been recurring again and again, as likewise herpetic eruption on the lower corneal border, will disappear; and the otherwise inevitable pannus like obscuration of the Cornea (on the same place) will be avoided. In many cases, already existing obscurations of the Cornea have also been cleared after the operation.

The only thing which in cosmetical respect can be objected, is that by the sewing up of the canthi externi the bulbi appear to be at a greater distance from each other than normally; and this gives to the countenance a peculiar expression.

While the paralysis of the orbicularis belongs to the rule with those who suffer from the smooth form, it must for the present remain undecided whether paralysis of levator and the muscle of the globe can occur as a consequence of leprosy.

We have once seen Ptosis in one eye but without being able to form any judgement as to the cause. Paralysis of the muscles of the globe we have never found without other plausible explanatory causes such as could not be brought into direct connexion with leprosy.

Fig. 1.

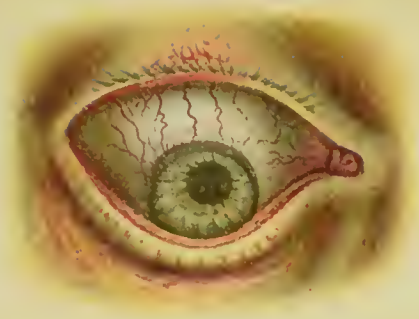


Fig. 2.

Fig. 3.

Fig. 5.

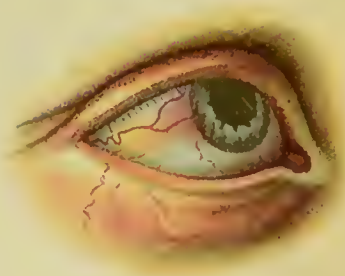


Fig. 6.

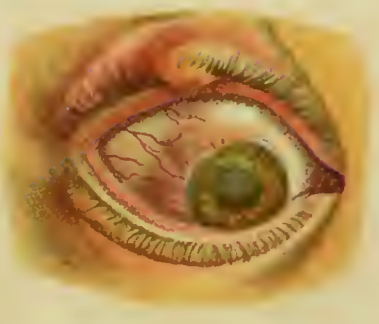


Fig. 7

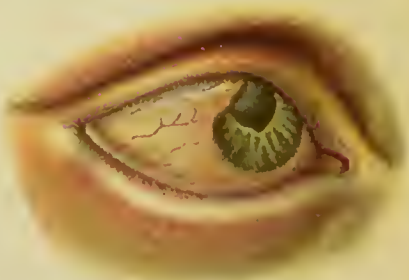
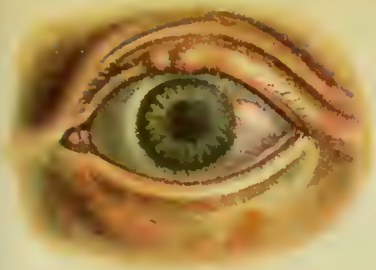


Fig. 8.



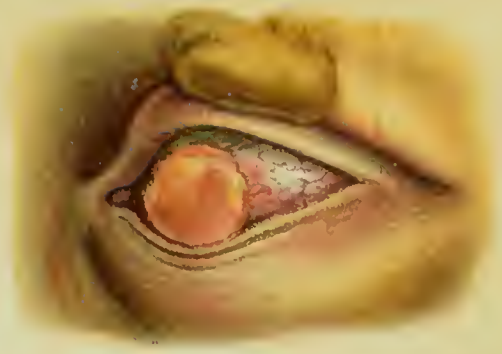


Fig. 10.

Fig. 16.

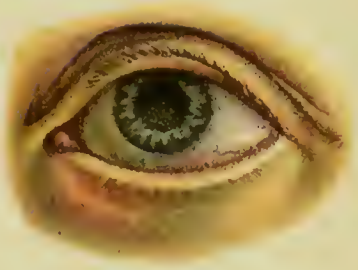


Fig. 17.

Fig. 18.

Fig. 24.

Fig. 27

Fig. 4.

Fig. II.

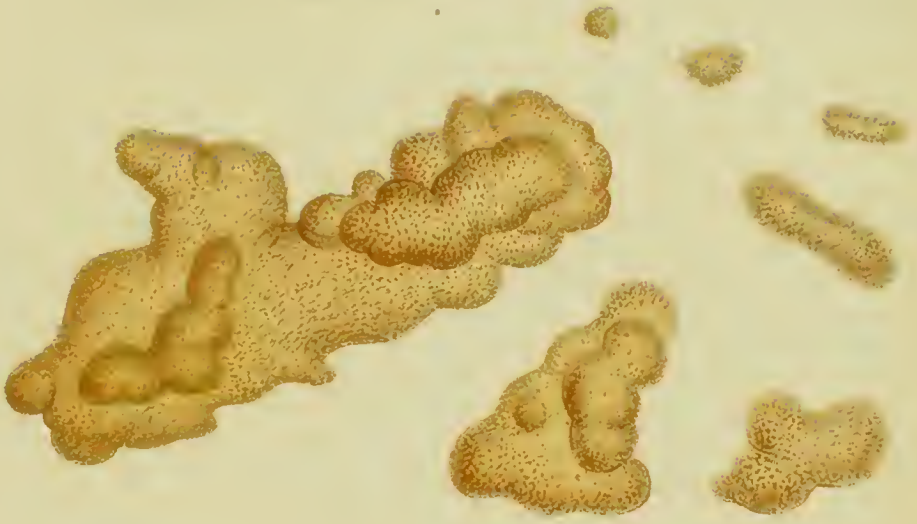


Fig. 13.

Fig. 14.

Fig. 15

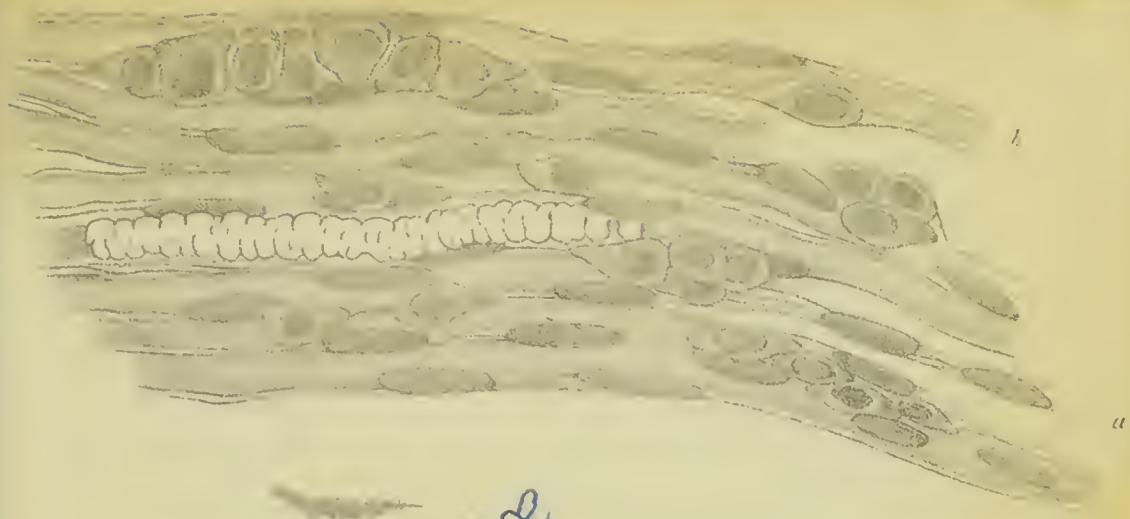


Fig. 20.

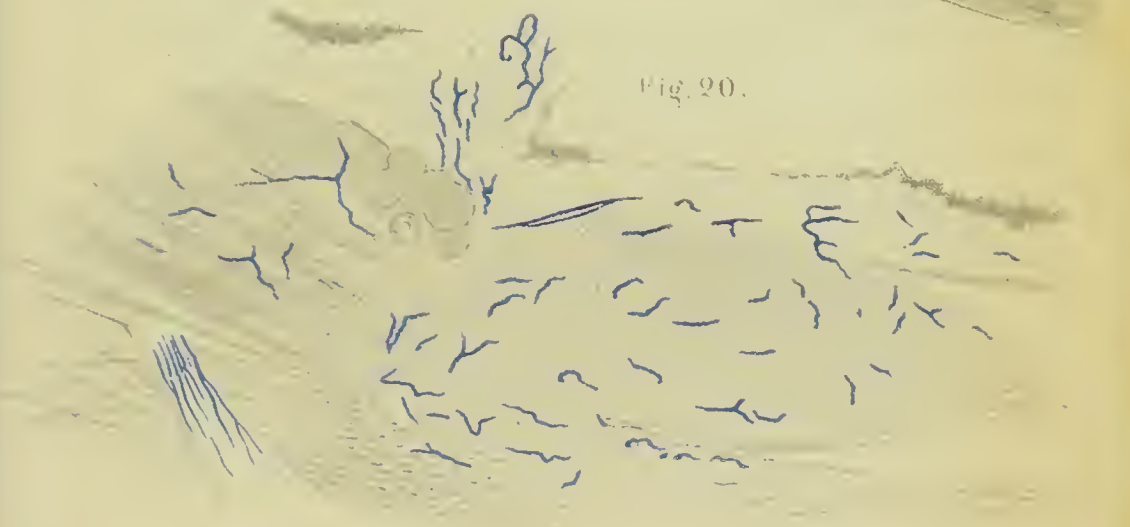


Fig. 21.

Fig. 22

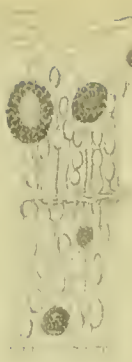
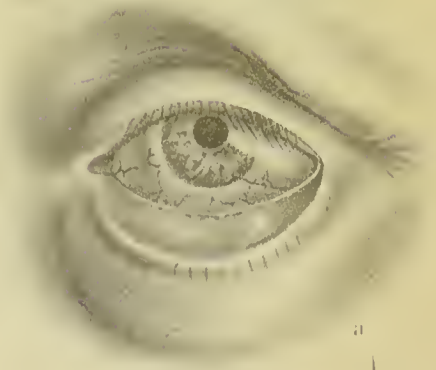


Fig. 25



a

Fig. 26.

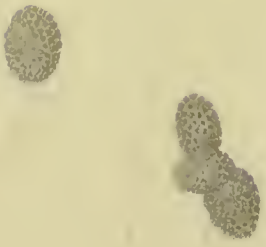


Fig. 28.

b